

Jason Graetz

Energy Sciences and Technology

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Field of expertise: Materials science; preparation of novel bulk materials using mechanochemical and wet chemical methods; synthesis of thin film and nanoscale materials using hydrogen-driven solid-state reactions, ballistic consolidation and physical vapor deposition; materials characterization using synchrotron x-ray diffraction, x-ray absorption spectroscopy, inelastic neutron scattering, transmission electron microscopy and electron energy-loss spectroscopy; thermodynamics and kinetics of energy materials (metal hydrides and lithium electrodes).

Education

Ph.D. Materials Science, California Institute of Technology, 2003

M.S. Materials Science, California Institute of Technology, 2000

B.A. Physics, Occidental College, 1998

Ph.D. dissertation

“Electronic Environments and Electrochemical Properties of Lithium Storage Materials”

Advisor: Prof. Brent Fultz, California Institute of Technology.

Electronic copy: <http://etd.caltech.edu/etd/available/etd-05162003-142018/>

Honors, Awards and Achievements

- Research featured in Chemical & Engineering News (2004), Chemical Engineering Progress Magazine (2004), Process Engineering Magazine (2004) and Chemical & Engineering News (2005).
- Invitation and stipend to the NATO Advanced Study Institute, Sozopol, Bulgaria, 2001
- Awarded a Class 1 NASA Tech Brief (NPO-20887), 2001
- Outstanding Comprehensive Project Award, Occidental College, 1998
- Sigma Pi Sigma, National Physics Honors Society, 1998
- Summer Undergraduate Research Fellow, Jet Propulsion Laboratory, 1997

Teaching Experience

Instrument Instructor, INEL CPS-120 x-ray diffractometer, 09/1999 – 06/2003

Teaching Assistant, Dept. of Materials Science, Caltech, 01/2000 - 06/2001

- Transmission Electron Microscopy and X-Ray Diffraction
- Advanced Transmission Electron Microscopy

Professional Experience

Postdoctoral Research Associate, Brookhaven National Laboratory, 2004 – Present

- Developed new, reversible complex metal hydrides.
- Determined the crystallographic structure of new hydride materials using synchrotron x-ray diffraction at the National Synchrotron Light Source (NSLS).
- Performed a series of experiments to measure pressure-composition isotherms and determine the decomposition thermodynamics of new complex metal hydrides.
- Characterized the local atomic environment and electronic structure of dopant atoms in sodium alanate using x-ray absorption spectroscopy (EXAFS and XANES) at the NSLS.

- Assisted with high-pressure studies of metal- and complex-metal hydrides using a diamond anvil cell and synchrotron x-ray diffraction (NSLS).
- Assisted in the development of metallurgically stimulated aluminum hydride and the preparation of a U.S. patent on this novel hydride.
- Assisted in writing proposals for the DOE-EERE Grand Challenge and the DOE-BES FY 04 Hydrogen solicitation.

Postdoctoral Fellow, California Institute of Technology, 2003

- Designed a novel synthesis method for the preparation of high capacity nanophase anodes by ballistic consolidation and physical vapor deposition.
- Characterized the thermodynamic, kinetic and electrochemical properties of lithium intermetallics for use as lithium anodes.
- Assisted in filing two U.S. patents on high capacity nanostructured lithium anodes.

Research Assistant, California Institute of Technology, 1998-2003

- Developed and performed inelastic neutron scattering experiments (Los Alamos Neutron Scattering Science Center) to study the phonon entropy of lithium intercalation in metal oxides.
- Proposed and developed a series of experiments to investigate the electronic charge rearrangement in lithium metal-oxide cathodes using TEM and electron energy-loss spectroscopy.
- Developed a novel in-situ x-ray diffraction experiment to study strains in lithium electrodes during electrochemical cycling.
- Studied the low temperature magneto-mechanical properties of rare-earth magnetic materials for the purposes of damping at cryogenic temperatures.

Patents

- G. Sandrock, J. Reilly, J. Graetz, W.M. Zhou, J. Wegrzyn, J. Johnson, K. Gross, "Metallurgically stimulated aluminum hydride" U.S. Patent in prep. 2005.
- J. A. Graetz, B. T. Fultz, C. Ahn, R. Yazami, "High-capacity nanostructured germanium-containing materials and lithium alloys thereof" filed April 2004.
- J. A. Graetz, B. T. Fultz, C. Ahn, R. Yazami, "High-capacity nanostructured silicon and lithium alloys thereof" U.S. Patent application No.20040126659 filed Sept. 10, 2003.

Book Chapters

J. Bentley and J. Graetz, "Application to ceramics, catalysts, and transition metal oxides", Chapter 8 in "Transmission electron energy loss spectrometry in materials science 2nd edition", C. C. Ahn ed., (Wiley-VCH, Weinheim, 2004) pp. 271-316. ISBN 0-471-32407-8.

Refereed Publications

- J. Graetz and J. J. Reilly, "Thermodynamics of the α , β and γ polymorphs of AlH_3 " *J. Alloys Comp.*, accepted (2005).
- J. Graetz and J. J. Reilly, "Decomposition kinetics of the AlH_3 polymorphs", *J. Phys. Chem. B*, **109** 22181 (2005).
- G. Sandrock, J. Reilly, J. Graetz, W.-M. Zhou, J. Johnson and J. Wegrzyn, "Alkali metal hydride doping of $\alpha\text{-AlH}_3$ for enhanced H_2 desorption kinetics" *J. Alloys Comp.*, accepted (2005).
- J. Graetz, Y. Lee, J. J. Reilly, S. Park and T. Vogt, "Structure and thermodynamics of the mixed alkali alanates", *Phys. Rev. B*, **71** 184115 (2005).

- J. Graetz and J. J. Reilly, "Nanoscale energy storage materials produced by hydrogen-driven metallurgical reactions", *Adv. Eng. Mat.*, **7** 597 (2005).
- G. Sandrock, J. Reilly, J. Graetz, W.-M. Zhou, J. Johnson and J. Wegrzyn, "Accelerated thermal decomposition of AlH₃ for hydrogen-fueled vehicles", *Appl. Phys. A*, **80** 687 (2005).
- J. Graetz, A.Y. Ignatov, T.A. Tyson, J.J. Reilly and J. Johnson, "Characterization of the local titanium environment in doped sodium aluminum hydride using X-ray absorption spectroscopy", *Mat. Res. Soc. Conf. Proc.* **837** (2005).
- J. Graetz, A.Y. Ignatov, T.A. Tyson, J.J. Reilly and J. Johnson, "X-ray absorption study of Ti-activated sodium aluminum hydride", *Appl. Phys. Lett.*, **85** 500 (2004).
- Y. Reynier, J. Graetz, T. Swan-Wood, P. Rez, R. Yazami and B. Fultz, "Entropy of Li intercalation in Li_xCoO₂", *Phys. Rev. B*, **70** 174304 (2004).
- J. Graetz, C.C. Ahn, H. Ouyang, P. Rez and B. Fultz, "White lines and *d*-band occupancy for the 3d transition-metal oxides and lithium transition-metal oxides", *Phys. Rev. B*, **69** 235103 (2004).
- J. Graetz, C.C. Ahn, R. Yazami and B. Fultz, "Nanocrystalline and thin film germanium electrodes with high lithium capacity and high rate capabilities", *J. Electrochem. Soc.*, **151** A698 (2004).
- J. Graetz, C.C. Ahn, R. Yazami, B. Fultz, "An electron energy-loss spectrometry study of charge compensation in LiNi0.8Co0.2O₂", *J. Phys. Chem. B*, **107** 2887 (2003).
- J. Graetz, C.C. Ahn, R. Yazami and B. Fultz, "Highly reversible lithium storage in nanostructured silicon", *Electrochem. Solid State Lett.*, **6** A194 (2003).
- J. Graetz, A. Hightower, C.C. Ahn, R. Yazami, P. Rez and B. Fultz, "Electronic structure analysis of chemically delithiated LiCoO₂ using electron energy-loss spectrometry", *J. Phys. Chem. B*, **106** 1286 (2002).
- J. Graetz, N. Good and B. Fultz, "Magneto-mechanical effects in textured polycrystalline Tb_{0.76}Dy_{0.24}", *J. Appl. Phys.*, **87** 5795-5797 (2000).

Non-Refereed Proceedings and Reports

- G. Sandrock, J. Reilly, J. Graetz, W.M. Zhou, J. Wegrzyn, J. Johnson and K. Gross, "Metallurgically stimulated aluminum hydride", Record of Invention, BNL No. 0423 (2004).
- B. Fultz, Y. Reynier, J. Graetz, T. Swan-Wood, P. Rez and R. Yazami, "Origin of the entropy of intercalation of Li into Li_xCoO₂", *Advanced Materials For Energy Conversion II Symposium* edited by D. Chandra, R. G. Bautista and L. Schlapbach, 311 (2004).
- J. Graetz, R. Yazami, C. C. Ahn, P. Rez and B. Fultz, "Electronic structure of oxygen in delithiated LiTMO₂ studied by electron energy-loss spectrometry", *Proc. NATO-ASI - New Trends in Intercalation Compounds for Energy Storage*, Vol. 61, ed. C. Julien (Kluwer Press, 2002) p. 405-412.
- J. Graetz, A. Hightower, C. C. Ahn, P. Rez and B. Fultz "Electronic structure analysis of LiCoO₂ using electron energy loss spectroscopy (EELS)", *Proc. Microsc. Microanal.* Vol. 7, ed. G. W. Bailey, R. L. Price, E. Voelkl, and I. H. Musselman (Springer, 2001) p. 1186-1187.
- J. Graetz, A. Hightower, C.C. Ahn, R. Yazami, P. Rez and B. Fultz, "Electron energy-loss spectrometry and mapping of oxygen in delithiated LiCoO₂", *Proc. Electrochem. Soc.*, pv. 2001-21, 12-20 (2001).
- J. Dooley, R. Chave, B. Fultz, A. Clark, N. Good and J. Graetz, "Progress in magnetoelastic vibration dampers", *NASA Tech Briefs* 25(12), Dec. 2001 p. 57.
- A. Hightower, J. Graetz, C.C. Ahn, P. Rez and B. Fultz, "The valence of Li in graphite", *Proc. Electrochem. Soc.*, pv.2000-21, 486 (2000).

- J. Dooley, N.R. Good, J. Graetz, R. Chave and B. Fultz, “Magnetostriction of polycrystalline Tb-Dy at cryogenic temperatures”, *Adv. Cryogenic Eng. (Materials)*, 46(a), 383 (1999).
- J.A. Dooley, C.A. Lindensmith, R.G. Chave, B. Fultz and J. Graetz, “Cryogenic magnetostrictive actuators: materials and applications”, *Proc. ACTUATOR 98, 6th International Conference on New Actuators*, Bremen, FRG, (1998).

Presentations

- “New Reversible Complex Metal Hydrides”, *March Meeting of American Physical Society*, 2005.
- “Doping of AlH₃ with alkali metal hydrides for enhanced decomposition kinetics”, *March Meeting of the American Physical Society*, 2005.
- “X-ray absorption study of Ti-doped sodium aluminum hydride”, *Fall Meeting of the Materials Research Society*, 2004.
- “Hydrogen storage: alanates”, *Battelle Fuel Cell Strategy Meeting*, 2004.
- “High lithium capacity and high rate capabilities in nanophase germanium electrodes”, *204th Meeting of the Electrochemical Society*, 2003.
- “Origin of entropy of intercalation of Li into Li_xCoO₂”, *204th Meeting of the Electrochemical Society*, 2003.
- “Raman evidence of spinel formation in delithiated cobalt oxide”, *204th Meeting of the Electrochemical Society*, 2003.
- “Thin film and nanophase group IV electrodes”, *203rd Meeting of the Electrochemical Society*, 2003.
- “A study of the Li K-edge in Li alloys”, *11th International Meeting on Li Batteries*, 2002.
- “Electronic structure of lithium intercalated metal oxides”, *Spring Meeting of the Materials Research Society*, 2002.
- “Electronic structure of chemically-delithiated LiCoO₂ studied by electron energy-loss spectrometry”, *NATO-Advanced Study Institute: New Trends in Intercalation Compounds for Energy Storage*, 2001.
- “Electronic structure analysis of chemically delithiated LiCoO₂ using electron energy-loss spectrometry”, *200th Meeting of the Electrochemical Society*, 2001.
- “Electronic structure analysis of LiCoO₂ using electron energy loss spectroscopy (EELS)”, *Microscopy & Microanalysis 2001 meeting*.

Professional Affiliations

American Physical Society (APS)
 American Association for the Advancement of Science (AAAS)
 Materials Research Society (MRS)
 Microbeam Analysis Society (MAS)

References

- **Brent Fultz**, Ph.D., Professor of Materials Science and Applied Physics
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